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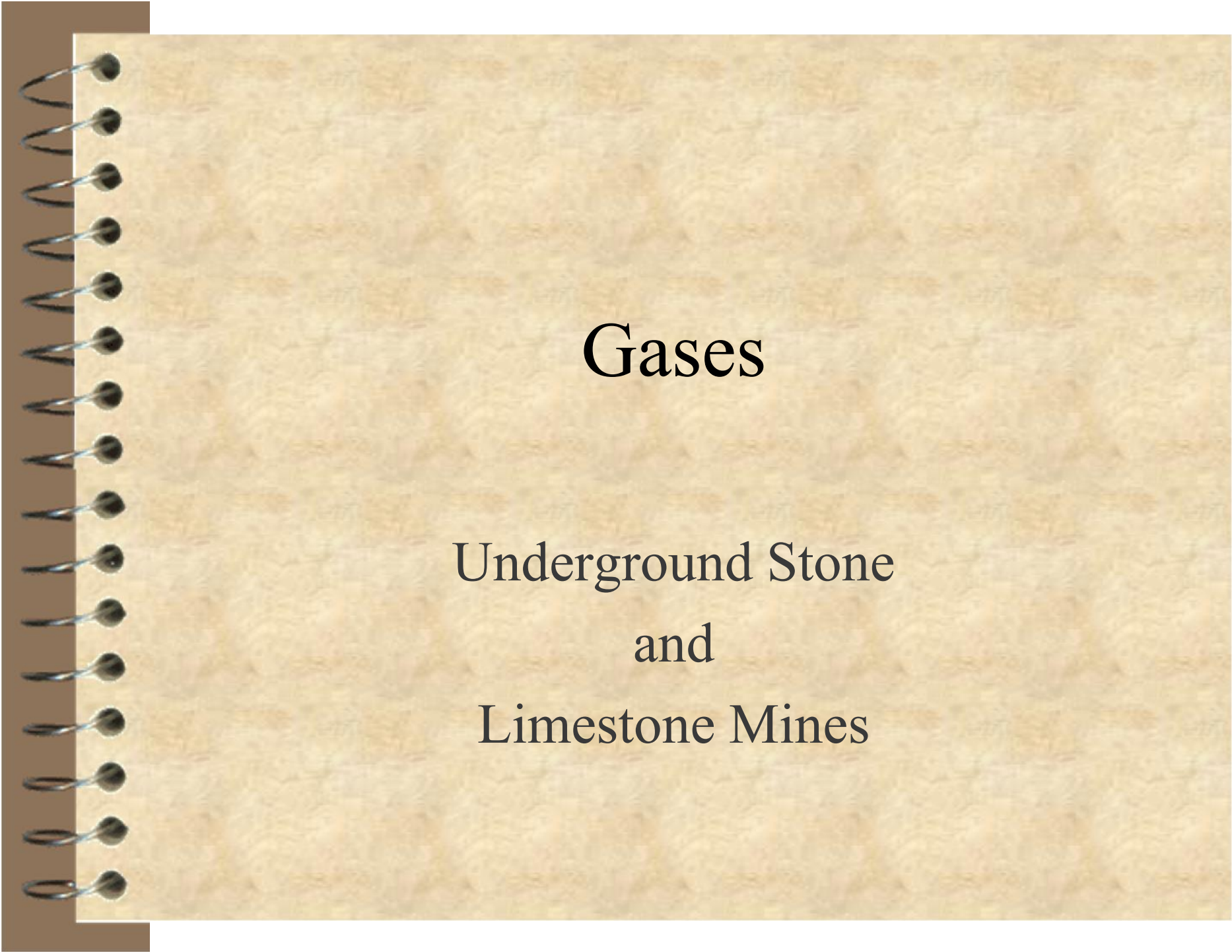
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A spiral-bound notebook with a light brown, textured cover. The spiral binding is on the left side. The text is centered on the cover.

Gases

Underground Stone
and
Limestone Mines



Objectives

- ☞ Identify mine gases
- ☞ Describe the hazards of mine gases
- ☞ Explain the effects of gas exposures
- ☞ Describe control measures
- ☞ Explain safe work procedures to reduce risks from gases



Consequences of Gas Incidents

☰ On April 10, 2000 four miners entered an area in the mine of very low oxygen and collapsed

☰ Quick action by others saved four lives

☰ A section foreman and a mine foreman entered an area of low oxygen . Both men collapsed

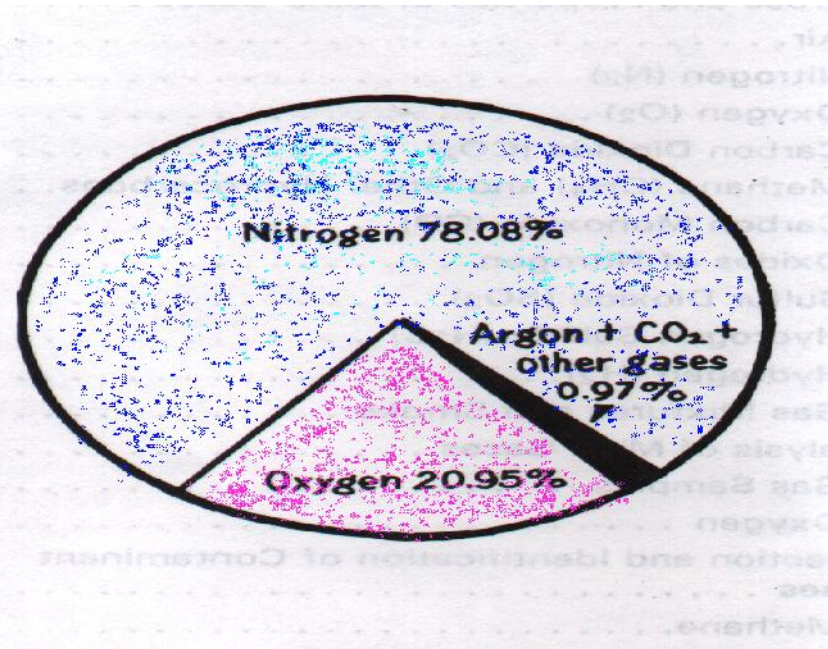
☰ The section foreman was asphyxiated while the mine foreman regained consciousness and summon help

Sources and Properties of Mines Gases

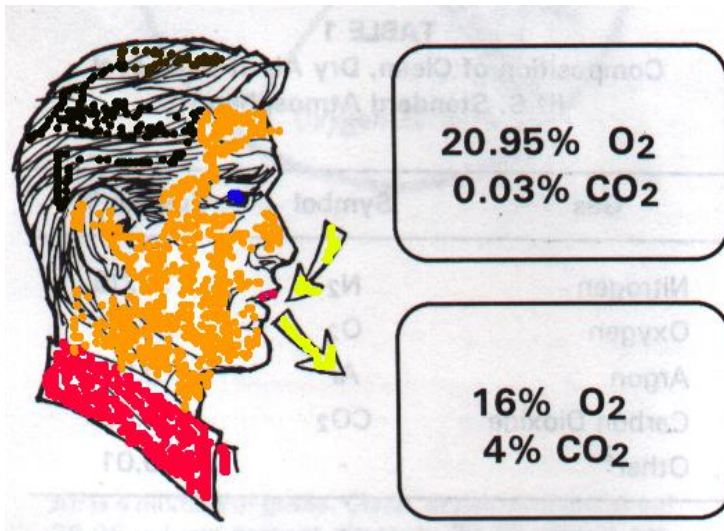
☞ Air

☞ The air we breath is a mixture of gases and is necessary for life.

☞ Air is used in mining to remove unwanted gases and dust.



Air



- At rest we breath about 16 times on average per/min and consume about 480 cu. inches of air.
- Moderate exercise we breath about 30 per min. and consume 3,000 cu. inches of air.



Air

- As air passes through a mine, it picks up other gases as well as dust formed by mining
- At the same time, air loses oxygen to the mine surroundings and to the people in the mine



Oxygen(O₂)

📄 Specific gravity: 1.105

📄 Oxygen will not burn or explode

📄 Source: Atmosphere

📄 Characteristics; No color, odor or taste



Percentage of Oxygen and Breathing

21%

Breathing easiest

19.5%

Minimum required by law

17%

Breathing faster & deeper

15%

Dizziness, buzzing noise, rapid pulse, headache, blurred vision

9%

Unconsciousness

6%

Breathing stops, cardiac arrest

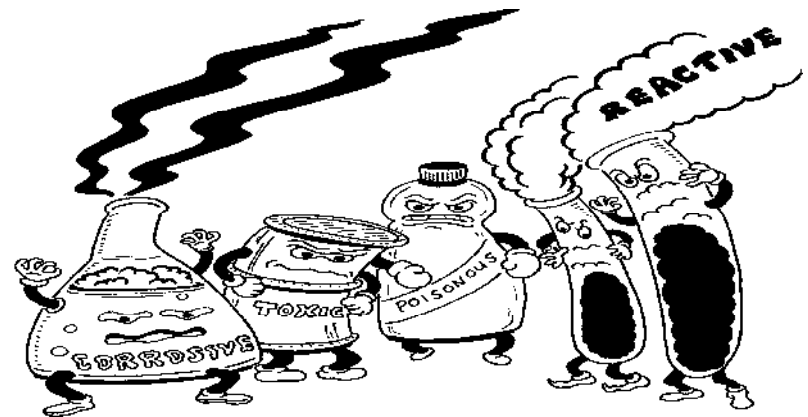


Legal requirements (MSHA) for Oxygen

- ☞ In mining (underground, shop, confined space entry, etc.) the air we breath must contain at least 19.5% oxygen (O₂) and not more than 0.5% of carbon dioxide
- ☞ Additionally, noxious (asphyxiant) or toxic(poisonous) gases must remain within prescribed threshold limit values (TLV)

Nitrogen Dioxide (O2)

- Specific gravity: 0.967
- Source: Atmosphere
- Characteristics: No color, odor or taste

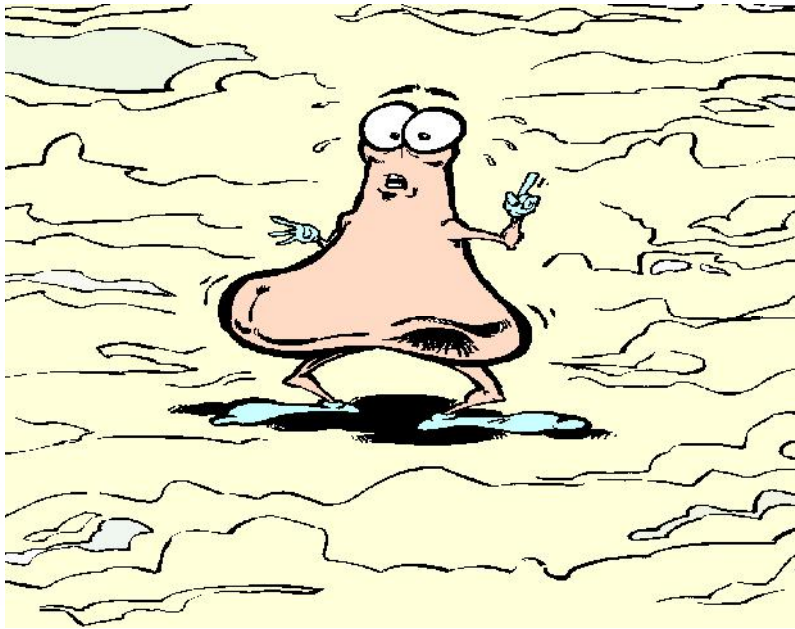




Oxides of Nitrogen

- Formed at high temperatures by diesel and gasoline engines, electrical discharges and blasting operations
- Toxic because they form very corrosive acids when mixes with moisture in the lungs
- Odor of blasting powder fumes

Carbon Dioxide (CO₂)



- Specific gravity: 1.529
- Source: Complete combustion, slow oxidation of carbon products Atmosphere
- Characteristics: No color or odor, acidic taste above 10%

Carbon Monoxide (CO)

- Specific gravity: 0.967
- Needs 6% O₂ to ignite
- Source: Incomplete combustion, diesels, gasoline engines
- Characteristics: No color, odor, or taste
- 300 times more attracted to the hemoglobin than oxygen



Hydrogen (H₂)



- Specific gravity:
0.0695
- Needs 5% oxygen to
ignite
- Source: Water on
super hot fire and
battery charging



Gas Mixtures and Smoke

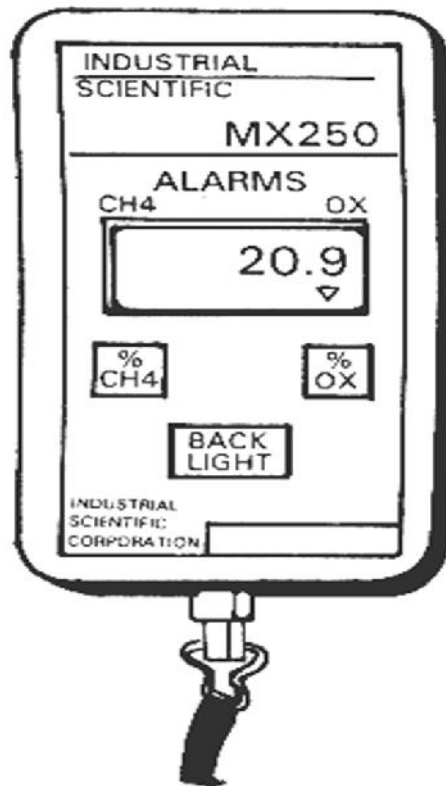
- ☞ Fire damp-methane
- ☞ Blackdamp-carbon dioxide and nitrogen in an oxygen-deficient atmosphere
- ☞ Afterdamp-gaseous products and smoke produced by a fire or explosion
- ☞ Rock gas-nitrogen and carbon dioxide
- ☞ Smoke-soot and tars suspended in the air

Gas Detection

One of the most reliable ways to evaluate the mine atmosphere is to use detectors approved by MSHA



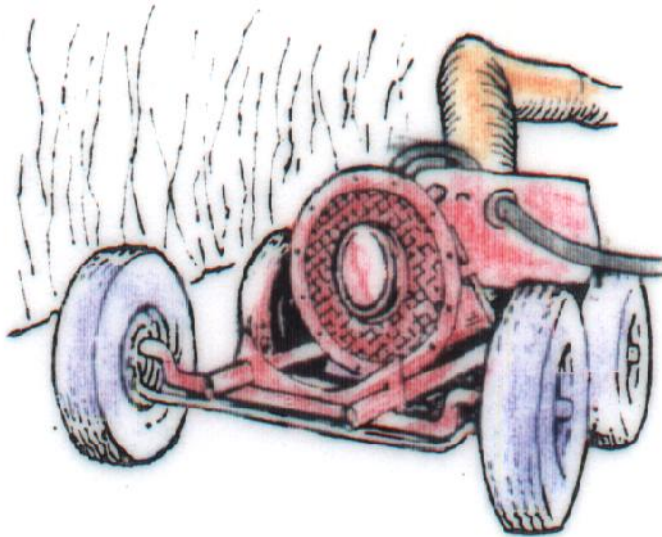
Gas Detection Instrument



- ☰ Detector must be calibrated
- ☰ Detector must be maintained in working order
- ☰ Operator of the detector must know the capabilities and limitations of detector

Control of Mine Gases

Under NORMAL
CONDITIONS
increased quantities of
air is the primary
defense against
unwanted gases



Control of Mine Gases



- ☞ ABNORMAL
CONDITIONS can be
created by;
- ☞ Ventilation problems
- ☞ Outbursts of gases
- ☞ Fires
- ☞ Explosions


Emergency Preparation Caused by Abnormal Gas conditions

- ☞ Know escape routes
- ☞ Know when and how to use self-rescuer
- ☞ Use of other respiratory protection
- ☞ Location of shelters
- ☞ How to build a barricade





Gas Quiz

 What is the normal percentage of oxygen in a mine atmosphere?

 21%




Gas Quiz

What is the minimum percentage of oxygen required in a mine for miners to work and travel?

19.5%



Gas Quiz

 At what percentage of oxygen will a person become unconsciousness in an oxygen deficient atmosphere?

 9%



Gas Quiz


☰ What gases are the result of blasting and what effect do these gases have on a person's lungs?

☰ Oxides of nitrogen

☰ Pulmonary edema




Gas Quiz


 What gas has proven deadly to not only miners but thousand of people in their homes?

 Carbon monoxide



Gas Quiz

 Carbon monoxide is present in a mine fire and the best protection that a miner has from this gas is to use what device?

 Self-rescuer




Gas Quiz

- ☞ Why is carbon monoxide so dangerous to a miner?
- ☞ Combines more readily than oxygen with the blood's hemoglobin and limits the oxygen carrying capacity of the blood



Gas Quiz

 What is a reliable way for detecting quantities of mine gases?

 Detector



Gas Quiz

📄 What is the best way to control mine gases?

📄 Increased ventilation



Gas Quiz

☰ What are several defense mechanisms that a miner can rely on if a fire or other abnormal gas conditions exist?

☰ Self-rescuer

☰ Escapesway to surface